INDOOR AIR QUALITY ASSESSMENT

Solmonese Elementary School
315 West Main Street
Norton, MA 02766

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
July 2005

Background/Introduction

At the request of building occupants and the Norton Board of Health (NBOH), the Massachusetts Department of Public Health's (MDPH), Center for Environmental Health (CEH) provided assistance and consultation regarding indoor air quality at the J.C. Solmonese Elementary School (SES), 315 West Main Street, Norton, Massachusetts. On March 10, 2005, a visit to conduct an indoor air quality assessment was made to this school by Cory Holmes, an Environmental Analyst in CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program. Mr. Holmes was accompanied by Gary Covino, Health Agent for the NBOH during the assessment. The school was previously visited by MDPH staff, in February 2001 to investigate an odor complaint in the kitchen area (MDPH, 2001).

The school is a red brick building that consists of two wings constructed in 1978. The single story wing contains the kitchen, cafeteria and kindergarten classrooms. The two-story wing contains general classrooms. Classrooms are designed in an open pod system, which are separated by movable walls/dividers. Windows are openable throughout the building.

Actions on Recommendations Previously Made by MDPH

As previously discussed, MDPH staff visited the building in February 2001 and issued a report that made recommendations to improve indoor air quality (MDPH, 2001). A summary of actions taken on previous recommendations is included as Appendix A of this assessment.

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were conducted with the TSI, Q-Trak, IAQ Monitor, Model 8551. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID). MDPH staff also performed visual inspection of building materials for water damage and/or microbial growth.

Results

This school has approximately 840 students and an employee population of approximately 80. Tests were taken under normal operating conditions and results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were elevated above 800 parts per million (ppm) parts of air in fifteen of thirty-nine areas surveyed, indicating inadequate air exchange in some areas. It is important to note that several areas were empty or sparsely populated at the time of the assessment, which can greatly reduce carbon dioxide levels.

Fresh air in exterior classrooms is supplied by unit ventilator (univent) systems (Picture 1). A univent draws air from outdoors through a fresh air intake located on the exterior wall of the building (Picture 2) and returns air through an air intake located at the base of the unit (Figure 1). Fresh and return air are mixed, filtered, heated and provided to classrooms through an air diffuser located in the top of the unit. Univents were operating in all but one area surveyed at the time of the assessment. Obstructions to airflow, such as desks and other items located on or in front of univent return vents, were also seen in a few classrooms. The assessment occurred shortly after a heavy snowstorm. As a result, several univent fresh air intakes were blocked by snowdrifts from plowing (Picture 3), which limited air intake. To function as designed, univents must remain free of obstructions and allowed to operate.

Exhaust ventilation is provided by wall or ceiling-mounted exhaust vents (Picture 4), which are ducted to motorized rooftop fans. These vents were operating in the majority of areas during the assessment. However, in a few areas no draw of air could be detected (Table 1). Without proper exhaust ventilation, environmental pollutants can build up in the indoor environment and lead to indoor air quality complaints. In addition, the location of exhaust vents in some classrooms can limit exhaust efficiency. In several classrooms, exhaust vents are located above hallway doors (Picture 5). When classroom doors are open, exhaust vents will tend to draw air from both the hallway and the classroom reducing the effectiveness of the exhaust vent to remove common environmental pollutants.

Mechanical ventilation for interior classrooms is provided by rooftop air-handling units (AHUs). Fresh air is distributed via ceiling-mounted air diffusers (Picture 6). Return air is ducted back to AHUs via ceiling-mounted return vents (Picture 7). These systems were operating during the assessment.

To maximize air exchange, the MDPH recommends that ventilation equipment operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The date of the last servicing and balancing was not available at the time of the assessment.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix B.

The temperature measurements ranged from 69° F to 78° F, which were very close to the MDPH recommended comfort guidelines (Table 1). The MDPH recommends that indoor air temperatures be maintained in a range of 70° F to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. In the learning center a ceiling-mounted supply diffuser was blocked with fiberglass insulation (Picture 6), reportedly to control drafts. This alteration, however, can affect the ventilation system balance and create uneven heating/cooling conditions in other adjacent areas.

The relative humidity measurements ranged from 10 to 20 percent, which were below the MDPH recommended comfort range in all areas the day of the assessment. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. The sensation of dryness and irritation is common in a low relative humidity environment. Relative humidity levels in the building would be expected to drop during the winter months due to heating. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

A number of rooms had water-stained ceiling tiles, indicating roof and/or plumbing leaks (Picture 8). Water-damaged ceiling tiles can provide a source of mold growth and should be replaced after a water leak is discovered and repaired. A portion of the building has a sloped metal roof and skylights that have a history of leaks (Picture 9). Examination of the skylights found broken panes of glass (Picture 10). Dark staining on the surface of gypsum wallboard (GW) (Picture 11), in areas adjacent to the skylights was observed. This staining may be evidence of mold growth.

The American Conference of Governmental Industrial Hygienists (ACGIH) and United States Environmental Protection Agency (US EPA) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (ACGIH, 1989; US EPA, 2001). If items are not dried within this time frame, mold growth may occur. The application of a mildewcide to mold colonized porous materials is not recommended.

Plants were noted in several classrooms. Some plants were placed near ventilation sources (Picture 12). Plants can be a source of pollen and mold, which can be respiratory irritants for some individuals. Plants should also be located away from univents to prevent the aerosolization of dirt, pollen or mold. Plants should also be properly maintained and equipped with drip pans.

Spaces between the sink countertop and backsplash were noted in several classrooms (Picture 13). Improper drainage or sink overflow can lead to water penetration moistening countertop wood, the cabinet interior and/or behind cabinets. Like other porous materials, if these materials become wet repeatedly they can provide a medium for mold growth.

Other Concerns

As discussed, the SES was previously visited by MDPH staff in February of 2001 to investigate odors in the kitchen area (MDPH, 2001). Although a number of steps have been taken to eliminate sewer system odors, kitchen staff reported to MDPH staff that occasional odors are detected. No odors were detected by occupants or MDPH staff during the reassessment in the kitchen area.

Indoor air quality can also be adversely impacted by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion products include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, MDPH staff obtained measurements for carbon monoxide and PM2.5.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide pollution and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

ASHRAE has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2000a). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS established by the US EPA, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2000a).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. Outdoor carbon monoxide concentrations were non-detect or ND (Table 1). Carbon monoxide levels measured in the school were also ND.

The US EPA also established NAAQS for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits for particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 micrograms per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2000a). This standard was adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA proposed a more protective standard for fine airborne particles. This more stringent, PM2.5 standard requires outdoor air particulate levels be maintained below 65 $\mu g/m^3$ over a 24-hour average (US EPA, 2000a). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective proposed PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 9 μg/m^3 (Table 1). PM2.5 levels measured indoors were in a range of 6 to 22 μg/m^3. Although PM2.5 measurements were above background in some areas, they were below the NAAQS of 65 μg/m^3. Frequently, indoor air levels of particulates can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulates during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system; cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Indoor air quality can also be negatively influenced by the presence of materials containing volatile organic compounds (VOCs). VOCs are carbon-containing substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. An outdoor air sample was taken for comparison. Outdoor TVOC concentrations were ND. Indoor TVOC concentrations were also ND (Table 1).

Please note, TVOC air measurements are only reflective of the indoor air concentrations present at the time of sampling. Indoor air concentrations can be greatly impacted by the use TVOC containing products. While no TVOC levels measured exceeded background levels, materials containing VOCs were present in the school. Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Cleaning products, aerosol cans and unlabeled spray bottles were found on countertops and/or beneath sinks in a number of classrooms (Picture 14). These materials may contain VOCs and other chemicals, which can be irritating to the eyes, nose and throat and should be stored properly and kept out of reach of students. Spray bottles should also be properly labeled in the event of an emergency.

Several other conditions that can affect indoor air quality were noted during the assessment. A number of exhaust/return vents, univent supply vents and filters for portable air conditioners (ACs) were observed to have accumulated dust (Picture 7). If exhaust vents are not functioning, backdrafting can occur, which can re-aerosolize accumulated dust particles. Re-activated ACs can also aerosolize dust accumulated on filters.

In an effort to reduce noise from sliding chairs, tennis balls had been sliced open and placed on chair legs (Picture 16). Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and off-gas VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix C (NIOSH, 1998).

Finally, ceiling tiles are made of a fiberglass material. In many areas the tiles were damaged resulting in exposed fiberglass in classrooms (Pictures 17 and 18). As discussed in the temperature section of this report, fiberglass insulation was stuffed into a ceiling-mounted supply vent (Picture 6), which can aerosolize fiberglass fibers. Fiberglass insulation can be a source of skin, eye and respiratory irritation to sensitive individuals.

Conclusions/Recommendations

Although action on previous MDPH recommendations, as well as several additional steps, have been taken to reduce the frequency and intensity of odors in the kitchen area (Appendix A); kitchen staff still report occasional odors. In view of the findings at the time of the visit, the following recommendations are made:

1. If odors reoccur and persist, contact a plumbing contractor, architect and/or general contractor to work in conjunction with SES kitchen staff to investigate and resolve odor issues in kitchen area.
2. Examine each univent for function. Operate univents while classrooms are occupied. Check fresh air intakes for repair and increase the percentage of fresh air intake if necessary.
3. Operate all ventilation systems that are operable throughout the building (e.g., gym, auditorium, classrooms) continuously during periods of school occupancy independent of thermostat control to maximize air exchange.
4. Inspect exhaust motors and belts for proper function. Continue with plans to repair and replace as necessary.

5. Remove all obstructions from supply vents and univents. Close classroom doors to improve air exchange. Work with/educate plowing contractors to prevent the blockage of univent air intakes.
6. Consult a ventilation engineer concerning re-balancing of the ventilation systems and the calibration of univent fresh air control dampers throughout the school. Ventilation industrial standards recommend that mechanical ventilation systems be balanced every five years (SMACNA, 1994).
7. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
8. Identify and repair sources of water leaks. Consider permanently sealing skylights to make watertight. Replace water-damaged ceiling tiles. These ceiling tiles can be a source of microbial growth. Examine the non-porous surface beneath the removed ceiling tiles and disinfect with an appropriate antimicrobial.
9. Clean the surface of GW using a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner with a brush attachment. If mold growth has *colonized* into the GW, removal or replacement should be considered.

10. For more information on mold and/or mold clean up consult "Mold Remediation in Schools and Commercial Buildings" published by the US EPA (US EPA, 2001). Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.

11. Seal areas around sinks to prevent water-damage to the interior of cabinets and adjacent wallboard. Inspect wallboard for water damage and mold growth, repair/replace as necessary. Disinfect areas with an appropriate antimicrobial, as needed.

12. Examine plants in classrooms for mold growth in water catch basins. Disinfect water catch basins if necessary. Remove plants from ventilation sources.

13. Remove debris and dust accumulated on the ventilation grilles.

14. Replace or seal damaged ceiling tiles to prevent exposure to fiberglass.

15. Change filters for air-handling equipment (e.g., univents, AHUs and ACs) as per the manufacturer's instructions or more frequently if needed. Vacuum interior of units prior to activation to prevent the aerosolization of dirt, dust and particulates. Ensure filters fit flush in their racks with no spaces in between allowing bypass of unfiltered air into the unit.

16. Store cleaning products properly and out of reach of students. Ensure spray bottles are properly labeled in case of emergency.

17. Consider discontinuing the use of tennis balls on furniture and replacing tennis balls with alternative "glides". Refer to Picture 18 for an example.

18. Consider adopting the US EPA document, *Tools for Schools* (US EPA, 2000b), as a means to maintaining a good indoor air quality environment in the building. This

document can be downloaded from the Internet at

http://www.epa.gov/iaq/schools/index.html.

19. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH's website: http://www.state.ma.us/dph/beha/iaq/iaqhoFtme.htm.

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Picture 1

Classroom Univent

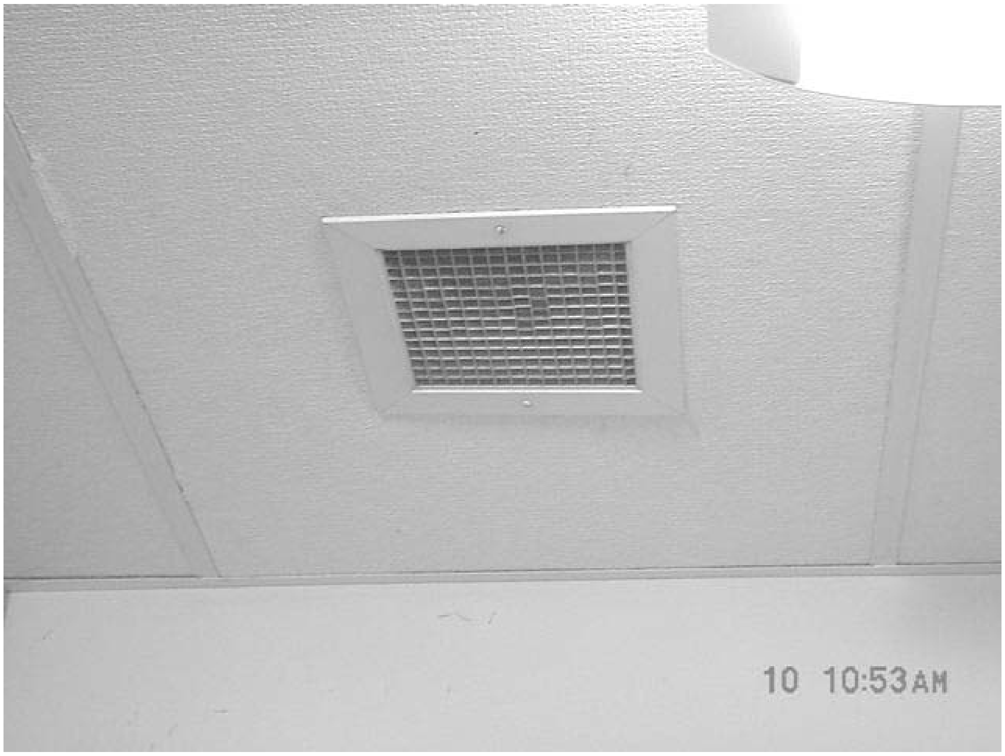
Picture 2

Univent Fresh Air Intake

Picture 3

Snow Bank Plowed against Univent Fresh Air Intake

Picture 4

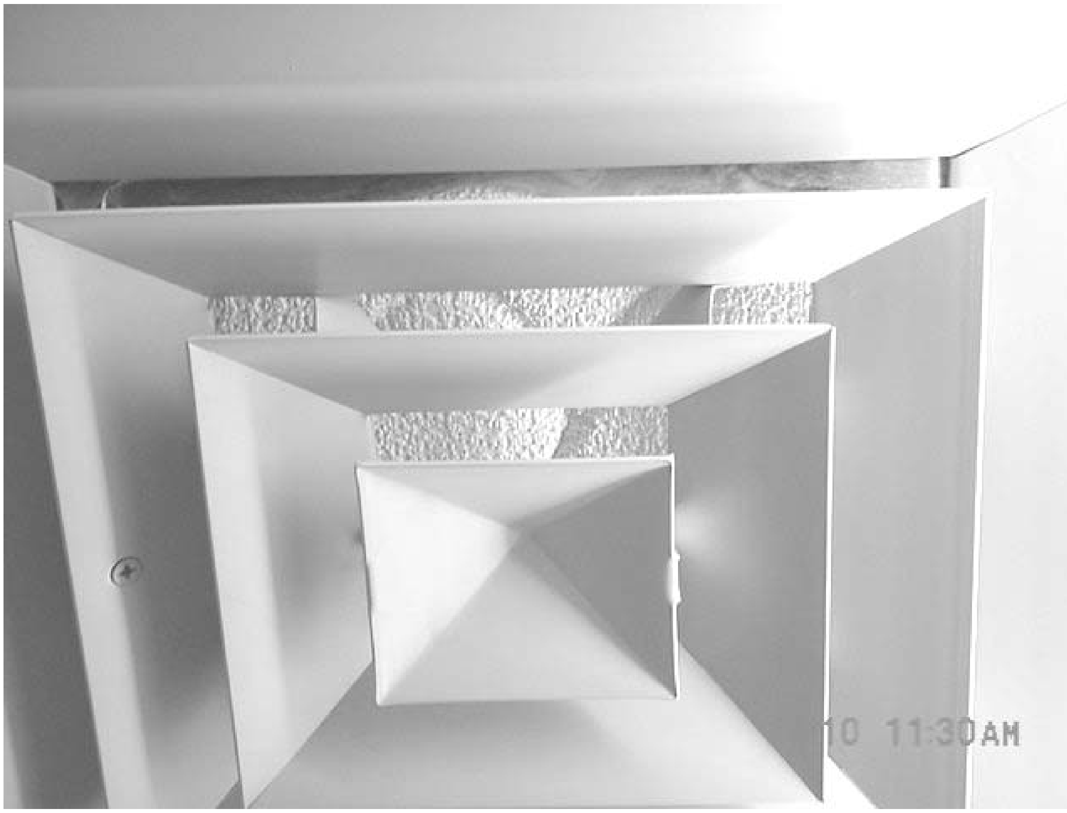


Classroom Exhaust Vent

Picture 5

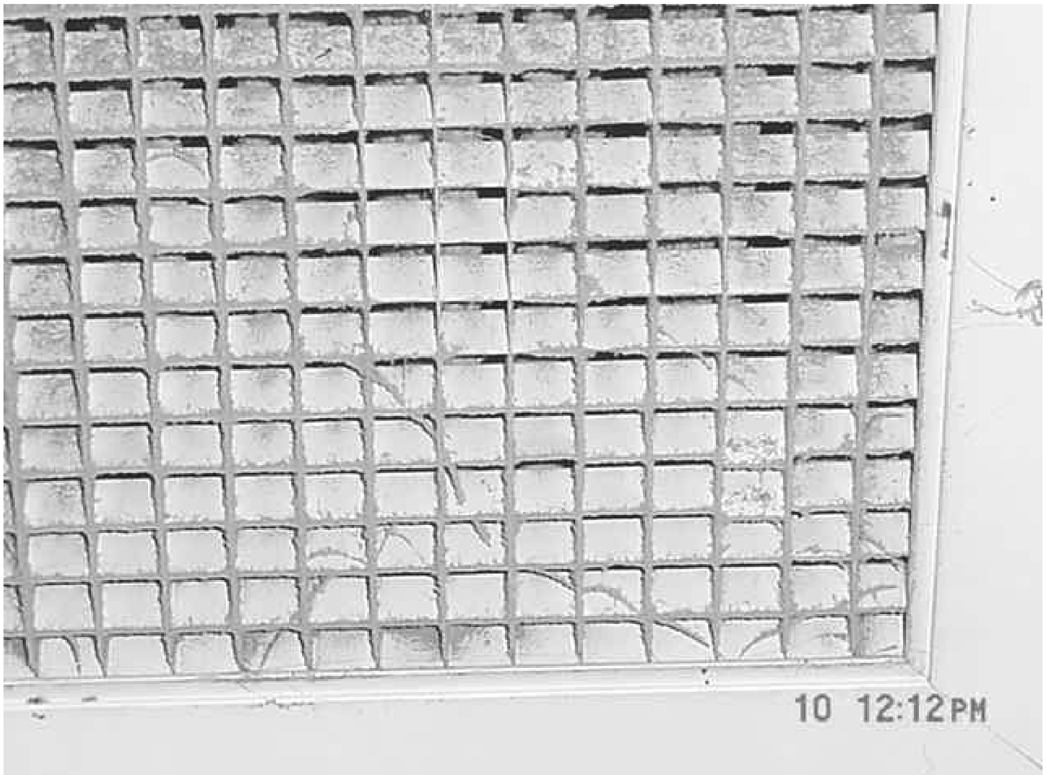
Proximity of Ceiling-Mounted Exhaust Vent to Open Classroom Door

Picture 6



Ceiling-Mounted Air Diffuser in Interior Classroom, Note Vent is Stuffed with Fiberglass Insulation

Picture 7



Ceiling-Mounted Return Vent, Note Dust Accumulation

Picture 8

Water Damaged Ceiling Tile

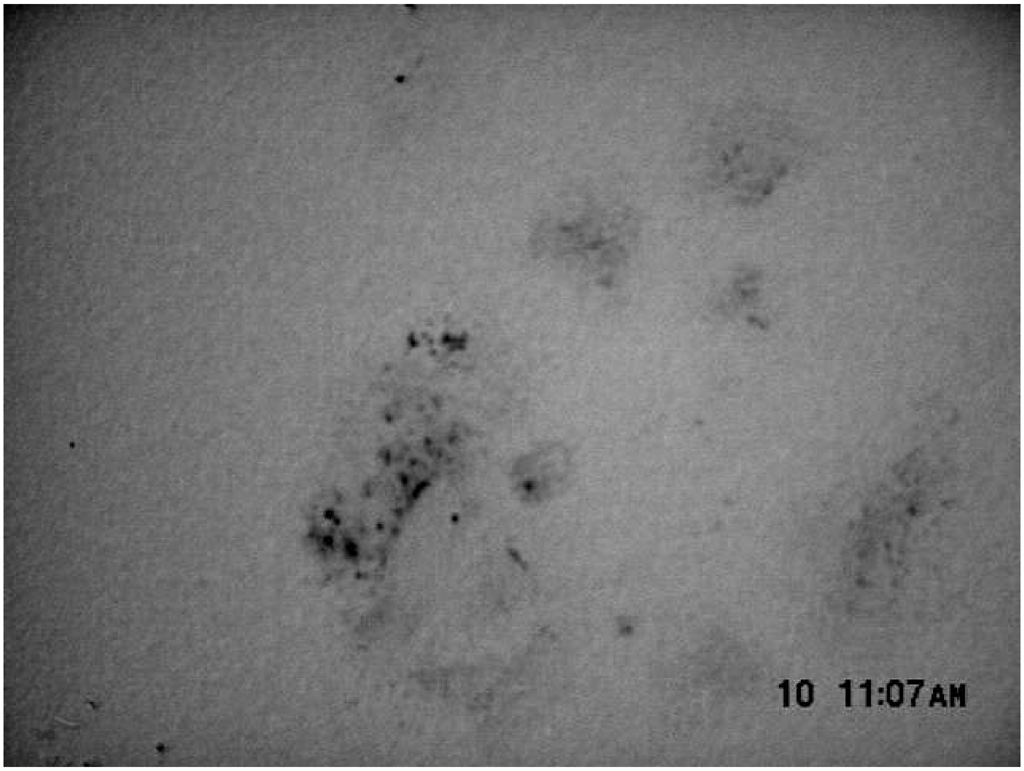
Picture 9

Sloped Metal Roof and Skylights

Picture 10

Broken Glass Skylight

Picture 11



Possible Mold Growth (as Indicated by Dark Stains) on Surface of GW

Picture 12

Flowering Plants near Univent Air Diffuser

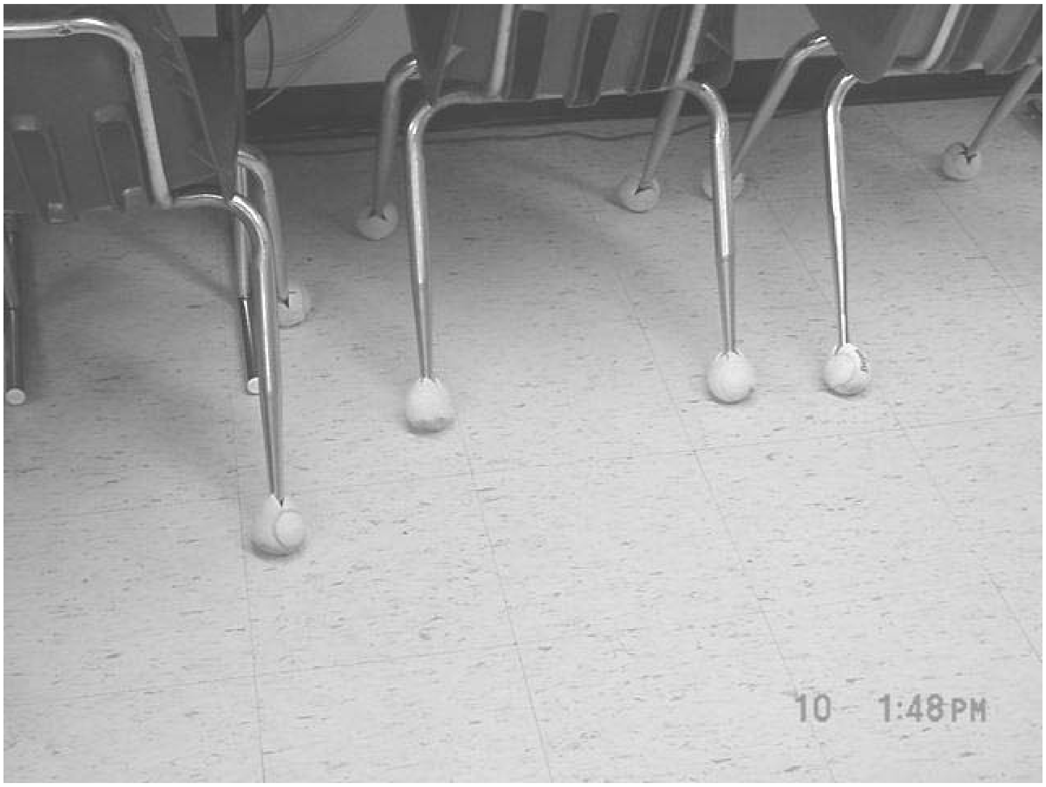
Picture 13

Breaches along Sink Countertop and Backsplash

Picture 14

Cleaning Products, Spray Bottles and Aerosol Cans beneath Classroom Sink

Picture 15



Tennis Balls on Chair Legs

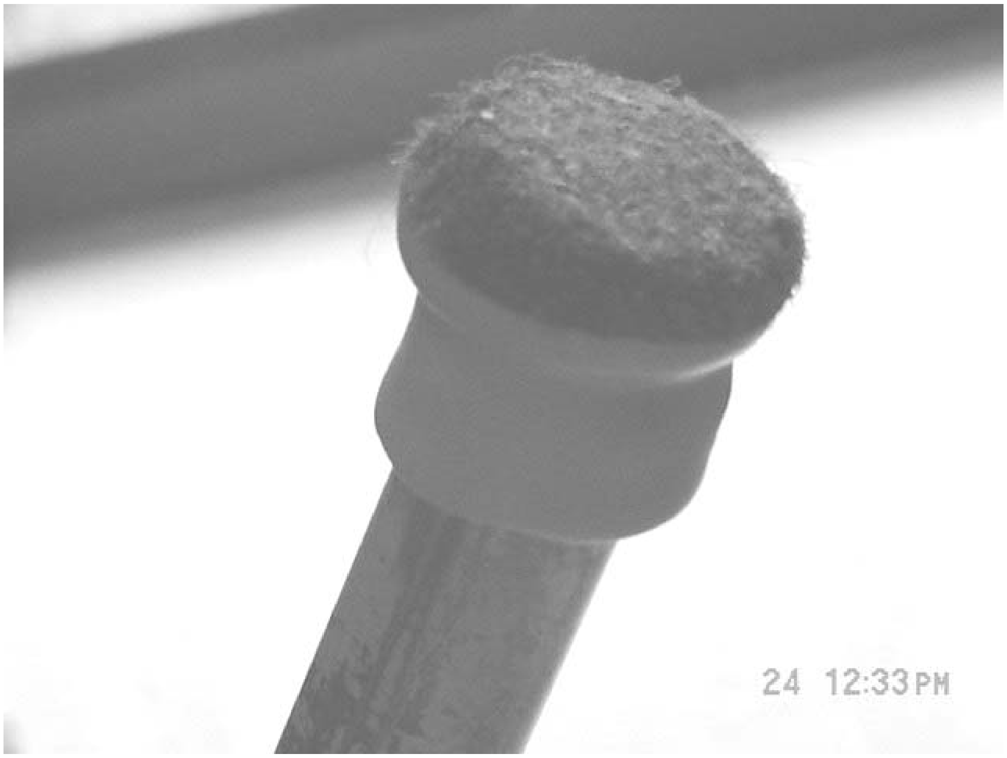
Picture 16

Damaged Ceiling Tile Exposing Fiberglass

Picture 17

Damaged Ceiling Tile Exposing Fiberglass

Picture 18



“Glides” for Chair Legs that can be used as an Alternative to Tennis Balls

J.C. Solmonese Elementary School **Indoor Air Results**

315 West Main St., Norton, MA 02766 **March 10, 2005**

Table 1

Location/Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
Background		32	14	361	ND	ND	9	N # open: 0 # total: 0			Comments: cold, mostly sunny, west winds 10-15 mph, gusts up to 25 mph.
145	19	73	20	1170	ND	ND	20	Y # open: 0 # total: 1	Y univent (off)	Y ceiling	Hallway DO, breach sink/counter, cleaners, plants, Comments: UV not operating-examined by NPS maintenance staff
144	19	71	19	1034	ND	ND	13	Y # open: 0 # total: 1	Y univent furniture	Y ceiling	Hallway DO, WD-ceiling, WD-GW, #WD-CT: 3, visible mold on GW, DEM, Comments: Chronic leaks from skylights
143	21	75	18	735	ND	ND	11	Y # open: 1 # total: 1	Y univent	Y ceiling	Hallway DO, breach sink/counter, Comments: exposed fiberglass

ppm = parts per million
µg/m3 = micrograms per cubic meter

AD = air deodorizer
AP = air purifier
aqua. = aquarium

AT = ajar ceiling tile
BD = backdraft
CD = chalk dust
CP = ceiling plaster
CT = ceiling tile
DEM = dry erase materials

design = proximity to door
FC = food container
G = gravity
GW = gypsum wallboard
M = mechanical
MT = missing ceiling tile

NC = non-carpeted
ND = non detect
PC = photocopier
PF = personal fan
plug-in = plug-in air freshener
PS = pencil shavings

sci. chem. = science chemicals
TB = tennis balls
terra. = terrarium
UF = upholstered furniture
WD = water damage
WP = wall plaster

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

J.C. Solmonese Elementary School

315 West Main St., Norton, MA 02766

Indoor Air Results

March 10, 2005

Table 1

Location/Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
141	22	76	18	987	ND	ND	15	Y # open: 1 # total: 4	Y univent	Y ceiling	Hallway DO
Work Room	4	74	14	681	ND	ND	11	Y # open: 0 # total: 1	N	Y ceiling	PC
147	5	75	13	603	ND	ND	8	Y # open: 0 # total: 1	Y univent	Y ceiling	Hallway DO
178	3	73	14	638	ND	ND	10	N # open: 0 # total: 0	Y ceiling	Y ceiling	Hallway DO
Learning Center	0	73	14	547	ND	ND	22	N # open: 0 # total: 0	Y univent items	Y ceiling	Hallway DO, Comments: supply vents blocked with insulation

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Table 1

Indoor Air Results

March 10, 2005

Location/Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
125	18	78	13	735	ND	ND	10	Y # open: 1 # total: 1	Y univent	Y ceiling	Hallway DO, breach sink/counter.
124	16	76	13	685	ND	ND	11	Y # open: 1 # total: 2	Y univent plant(s)	Y ceiling	Hallway DO, cleaners, Comments: improperly labeled cleaning products-not in original container.
121	18	75	15	927	ND	ND	10	Y # open: 0 # total: 1	Y univent	Y ceiling	Hallway DO, DEM, cleaners.
123	1	71	13	599	ND	ND	8	Y # open: 0 # total: 3	Y univent	Y ceiling	Hallway DO, breach sink/counter, DEM, Comments: 20 occupants gone 45 min.
PT OT	0	72	13	553	ND	ND	16	N # open: 0 # total: 0	Y ceiling	Y ceiling	

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Comfort Guidelines

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600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

J.C. Solmonese Elementary School | **Indoor Air Results**

315 West Main St., Norton, MA 02766 | **March 10, 2005**

Table 1

Location/Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
106	1	72	15	750	ND	ND	10	Y # open: 0 # total: 1	Y	Y ceiling	Hallway DO, Comments: 23 occupants gone 5 min
103	0	72	10	836	ND	ND	10	Y # open: 0 # total: 2	Y univent	Y ceiling	Hallway DO, Comments: occupants at lunch 10 min
101	0	73	16	789	ND	ND	8	Y # open: 0 # total: 1	Y univent furniture	Y ceiling	Hallway DO, cleaners, Comments: outside air intakes covered by snow from plowing
107	0	71	18	927	ND	ND	9	Y # open: 0 # total: 1	Y univent	Y ceiling	Hallway DO, cleaners, Comments: Damaged CTs-fiberglass, univent air intakes covered by snow from plowing
163	3	72	15	616	ND	ND	6	N # open: 0 # total: 0	Y ceiling	Y ceiling	Hallway DO, cleaners

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J.C. Solmonese Elementary School

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March 10, 2005

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									Supply	Exhaust	
Nurse	1	73	16	793	ND	ND	10	N # open: 0 # total: 0	Y ceiling	Y ceiling	Hallway DO, cleaners
Nurse sick bay	0	74	16	826	ND	ND	9	Y # open: 0 # total: 2	N	Y ceiling	Hallway DO, plant(s) on carpet
Main Office	5	75	15	708	ND	ND	10	Y # open: 0 # total: 1	Y ceiling		
gym	0	74	15	820	ND	ND	12	N # open: 0 # total: 0	Y ceiling	Y ceiling	
kitchen	20	69	12	406	ND	ND	9	N # open: 0 # total: 0	Y ceiling	Y ceiling	Exterior DO, Comments: periodic odor complaints, back door open

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Cafeteria	180	72	15	659	ND	ND	9	N # open: 0 # total: 0	Y ceiling wall	Y ceiling wall	Hallway DO
7	22	71	18	842	ND	ND	11	Y # open: 0 # total: 2	Y univent	Y ceiling	Hallway DO, DEM, cleaners, Comments: Univent air intake blocked with snow from plowing
6	19	72	17	773	ND	ND	13	Y # open: 0 # total: 2	Y univent	Y ceiling	Hallway DO, breach sink/counter, PF, cleaners
1 & 2	38	72	20	1171	ND	ND	9	Y # open: 0 # total: 5	Y univent	Y ceiling	Hallway DO, PF, cleaners, Comments: open classroom
201	4	74	14	723	ND	ND	8	Y # open: 0 # total: 3	Y univent	Y ceiling	Hallway DO, TB, cleaners

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J.C. Solmonese Elementary School

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Indoor Air Results

March 10, 2005

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									Supply	Exhaust	
244	17	75	19	1028	ND	ND	14	Y # open: 1 # total: 4	Y univent	Y ceiling	Hallway DO, DEM, TB
Art	24	74	14	713	ND	ND	8	Y # open: 0 # total: 1	Y wall	Y ceiling	Hallway DO, Comments: vented kiln
Computer Room	1	74	15	652	ND	ND	7	Y # open: 0 # total: 1	Y univent	Y ceiling	Hallway DO, TB
223	0	73	14	756	ND	ND	12	Y # open: 0 # total: 2	Y univent	Y ceiling	Hallway DO, Comments: occupants at lunch
227	20	73	16	1013	ND	ND	17	Y # open: 0 # total: 1	Y univent	Y ceiling	Hallway DO, window-mounted AC

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Library	26	72	12	502	ND	ND	6	N # open: 0 # total: 0	Y ceiling	Y ceiling	
LMC workroom	1	75	13	591	ND	ND	10	N # open: 0 # total: 0	Y ceiling	Y ceiling	Hallway DO, PC, laminator
223	0	73	14	756	ND	ND	12	Y # open: 0 # total: 2			Hallway DO, Comments: occupants at lunch
227	20	73	16	1013	ND	ND	17	Y # open: 0 # total: 1			Hallway DO, window-mounted AC, Comments: AC filter dusty
241	14	74	19	1002	ND	ND	8	N # open: 0 # total: 4	Y univent	Y ceiling	Hallway DO, TB

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									Supply	Exhaust	
243	19	75	19	1006	ND	ND	9	Y # open: 0 # total: 2	Y univent	Y ceiling	Hallway DO, TB

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Appendix A

The following is a status report of action(s) taken on previous MDPH recommendations (**in bold**) based on reports from building staff, Norton Public Schools (NPS) officials, documents, photographs and MDPH staff observations.

- **Reseal/replace the sewer vent in the kitchen storeroom to render this pipe airtight.**

  Action Taken: Following the 2001 MDPH assessment, the pipe was found to be corroded and subsequently replaced by a licensed plumbing firm.

- **Extend the kitchen sewer vent pipes in a manner similar to the sewer vent pipes on the western side of the two-story wing roof. [This activity is planned (NPS, 2001)].**

  Action Taken: Vent pipes were extended to above 5-feet over the plane of the roof.

- **Repair the kitchen storeroom exhaust vent and operate during school hours.**

  Action Taken: Vent was repaired and operable.

In addition, to the above mentioned actions, the following additional steps were reportedly taken in the kitchen area to reduce/prevent odors.

- Pipes that connect to the kitchen grease trap were excavated, snaked and/or replaced.
- The waste stack in the kitchen storage area was removed and couplings were replaced to prevent further leakage.
- The dishwasher drain line was examined and repaired by the NPS plumbing contractor.